



Ares I-X Avionics System

Overview

- The avionics system controls lift-off, flight, separation, recovery; collects, records, and telemeters engineering data
- On-board Flight Control: Launch, Ascent, Separation, and Recovery
 - Thrust Vector Controller (TVC)
 - Roll Control (RoCS)
- Flight Software
- Data Acquisition & Recording (Includes Sensors)
 - Developmental Flight Instrumentation (DFI)
 - Operational Flight Instrumentation (OFI)
- Telemetry
- Power
- First Stage Avionics Module (FSAM) development
- Ground Command, Control, & Communication System (GC3)
- Electrical Ground Support Equipment (EGSE)

Avionics control every active portion of the Ares I-X test flight, from liftoff to navigation to data collection and parachute deployment. The avionics system functions as the rocket's "brains and nervous system" as it incorporates the NASA-provided flight control algorithm. The avionics provides information on the environment and controls movement and direction. In addition to controlling the rocket, the avionics will be collecting, transmitting, and storing engineering data before, during, and after the flight. The information gathered by the Ares I-X avionics system will be incorporated into further computer simulations and analyses to help NASA better understand how the Ares I crew launch vehicle will fly and interact with its environment.



Engineering drawing of the first stage avionics module (FSAM)



The ascent thrust vector controller (ATVC) communicates between Atlas V and Space Shuttle hardware to send steering commands to the first stage nozzle.

Hardware

- The Avionics system consists of heritage Atlas hardware, modified Solid Rocket Booster (SRB) avionics, new box developments, and Commercial-Off-the-Shelf (COTS) systems
- Jacobs Engineering/ Lockheed Martin Space Systems are the primary supplier and integrator of the Avionics system
 - Fault Tolerant Inertial Navigation Unit (FTINU)– Atlas heritage
 - Redundant Rate Gyro Unit (RRGU)– Atlas heritage
 - Flight Software– modified Atlas
 - Ground Communication, Command, & Control (GC3) System– new development
 - First Stage Avionics Module (FSAM)– new development



The Ground Command, Control, and Communication (GC3) system, installed in the mobile launch platform, will enable Mission Control to monitor, interact with, and launch Ares I-X from Launch Complex 39B

NASAfacts

- Ascent Thrust Vector Controller (ATVC)–new development
- COTS Developmental Flight Instrumentation (DFI)
- ATK/USA are heritage Shuttle hardware and SRB-Derived Avionics (SDA) avionics
 - Altitude Switch Assembly (ASA)–Shuttle heritage
 - Ignition/Separation Controller (ISC)–modified heritage
 - Recovery Controller Unit (RCU)–modified heritage
 - Auxiliary Power Unit Controller (APUC)–modified heritage



Avionics team members observe the thrust vector control system as it is test-operated by the ascent thrust vector controller (ATVC)

Avionics hardware is installed in nearly every section of the Ares I-X flight test vehicle, from the Crew Module and Launch Abort System (CM/LAS) simulator to the aft skirt of the first stage. DFI sensors are mounted onto the leading edge of the rocket on the CM/LAS, along the inside and outside of the Upper Stage Simulator, the Roll Control System, the SRB, and the aft skirt of the first stage. The Redundant Rate Gyroscope Units (RRGU) are mounted in the forward and aft ends of the rocket and will continually monitor the rocket's location on the ground and in space. The RRGUS feed information to the Fault Tolerant Inertial Navigation Unit (FTINU), the flight computer, which is mounted beneath the ballast in the middle of the Upper Stage Simulator to minimize movement. The Ares I-X Guidance, Navigation, and Control (GN&C) system simulates the function and location of the Ares I GN&C system and will provide valuable data for the completion of the Ares I flight control software.

The First Stage Avionics Module (FSAM), located inside the fifth segment simulator, contains the majority of the avionics hardware. The flight data recorder is located on the FSAM. When the first stage is recovered, the data recorder will be removed; data will be downloaded, analyzed, and provided to the Ares I developers.

This hardware and software will provide critical engineering data that will be used for the final design of the Ares I crew launch vehicle, which will be analyzed at the Critical Design Review in 2011.



The Atlas V Fault Tolerant Inertial Navigation Unit (FTINU) servers as the flight computer and part of the Guidance, Navigation, and Control (GN&C) System

Software

- Flight Software (FSW) is Atlas heritage SW modified to control Ares I-X and incorporate the NASA-provided guidance and control algorithm
- Ground Software is also Atlas an Atlas-based system adapted and tested to work in conjunction with the existing KSC systems



The Ares I-X avionics undergoing testing in the Systems Integration Laboratory (SIL)

Testing

- The Ares I-X avionics systems are integrated and tested in a Systems Integration Laboratory (SIL) at a Lockheed Martin facility in Denver, Colorado.
- The SIL performs integrated testing using “Test Like You Fly” (TLYF) principle. This approach provides that
 - No function, environment, or stress should be experienced by a product for the first time during its mission
 - All embedded software is tested on functionally equivalent development hardware before using on deliverable hardware
 - Ensures a realistic interaction between computers and hardware
 - Provides a flight-like environment to perform trouble-shooting during the integration process

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